ISFSI

INSTRUCT-O-GRAM

THE HANDS-ON TRAINING GUIDE FOR THE FIRE INSTRUCTOR

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SELF-CONTAINED BREATHING APPARATUS

TIME REQUIRED

Three Hours

MATERIALS

Personal Protective Clothing
Personal Alert Safety System (PASS) Device
Self-Contained Breathing Apparatus

MOTIVATION

Instructor should stress the need for safety in all aspects of emergency service duties and impress upon the students the roles of attitude, training, and awareness. Proper knowledge and use of self-contained breathing apparatus is necessary to help provide a sate working environment for the emergency service provider.

OBJECTIVE

The student will be able to describe important aspects of safety and demonstrate practical application as it pertains to emergency service provider operations from memory, without assistance, to an accuracy of 70% and the instructor's satisfaction. The student will be able to identify the basic functions and uses of and properly don and doff self-contained breathing apparatus.

OVERVIEW

Self-Contained breathing Apparatus

- Hazards, operation, and components
- Maintenance and inspection
- Donning and doffing procedures and safety checks
- Controlled breathing techniques
- Emergency procedures
- Changing cylinders

I. HAZARDS, OPERATION, AND COMPONENTS

A. Respiratory Hazards

1. Oxygen deficiency
   a. Normal air contains 21% oxygen
   b. At least 14% needed to sustain life
2. Toxic gases
   a. May be present from normal processes taking place (certain levels are permitted in the workplace.
   b. May be result of accidental release
   c. Normal by-product of combustion

d. Most taken in to body through inhalation

e. May not be visible

3. Superheated gases

a. Normal by-product of combustion

b. Can cause temporary or permanent damage to respiratory system

4. Smoke

a. Normal by-product of combustion, especially incomplete combustion

b. Can affect body functions

5. SCBA protects fire fighter from most respiratory hazards encountered in a fire.

B. Method of Operation

1. Compressed air from cylinder is supplied to wearer

a. Inhalation opens valve in regulator

b. Regulator allows air to flow to facepiece

c. Exhalation closes valve in regulator, stopping flow and opens exhalation valve in facepiece to atmosphere

2. Air from cylinder is allowed to pass through regulator. Upon inhalation, pressure is reduced in facepiece. Regulator supplies more air to compensate for pressure drops. Exhalation valve forced closed by spring tension causing slight pressure buildup inside facepiece

a. Maintains slightly higher than atmosphere pressure

b. Prevents leaks from outside into facepiece

C. SCBA Components

1. Cylinder Types

a. 30 minute high pressure system

1) Volume – 45 cu. ft. at 4,500 psi

2) Cylinder is about half the size of a 30 minute low pressure cylinder, providing small firefighter profile

3) Average unit weight – 23 lbs

b. 60 minute high pressure system

1) Volume – 88 cu ft. at 4,500 psi

2) Cylinder is slightly larger than 30 minute low pressure

3) Average unit weight – 30 lbs

2. Cylinder valve and gauge

3. Markings – serial number, hydrostatic test date, DOT markings, fill pressure

4. Safety or over-pressure plug – if, during filling, the cylinder is over filled, a small metal disc will rupture and the air will escape to the outside

5. A full cylinder rated at 30 minutes by the NIOSH/MSHA (Federal non-fire service agencies) will last about 15 to 20 minutes depending on

a. Physical condition

b. Psychological stability or make-up

c. Ability to control breathing

d. Training and experience

e. Work activity

f. Other factors

6. Harness – a device to hold and carry the breathing apparatus assembly on the back

7. Backplate – holds the cylinder in place with a cylinder strap; equipped with adjustable band for 30- and 60-minute cylinders

8. Shoulder strap – straps to carry the assembly on the back

9. Chest strap – holds the shoulder straps in position

10. Waist strap – holds the harness on the back and prevents the assembly from sliding

11. Approval label – NIOSH/MSHA

12. Low pressure warning device

a. Device to warn that your air supply is running low

b. Activates at approximately 25% of rated working pressure (3 to 5 minutes) of air left in the cylinder, depending on
   1) Physical condition
   2) Psychological stability or make-up
   3) Ability to control breathing
   4) Training and experience
   5) Work activity
   6) Other factors

c. Location and type of device

13. High pressure hose
   a. Carries air, at cylinder pressure, from cylinder to first and second stage regulators
   b. Connector from high pressure hose
      1) Should be finger tight. If the connector still leaks, snug up with hand. If it still leaks, check "O" ring. Never over tighten. It will damage "O" ring
      2) Keep spare "O" rings with apparatus, replace as necessary
      3) Never use wrench, or full hand power on connector

14. Regulator assembly – a device which reduces the high pressure air from the cylinder to a lower pressure
   a. First stage mounted on side of backpack
   b. Gauge – tells how much air is remaining in the cylinder
      1) Connected to high pressure hose and fastened to left shoulder strap
      2) Shows pressure reading whenever pressure on system
      3) Have student compare cylinder and regulator gauge, go by lowest pressure
      4) Should never be more than 100 psi difference. If so, have checked by service personnel
   c. Facepiece mount regulators
      1) No mainline valve – system is activated by purging facepiece and then inhaling
      2) Does not have by-pass valve – system is designed to fail in the open position
      3) Purge valve – for purging contaminants from the facepiece
      4) Donning switch – shuts off air to facepiece prior to doffing
      5) Locking device – to assure regulator to facepiece connection
      6) Gasket – sealing regulator to facepiece

15. Facepiece assembly
   a. Facepiece – covers/protects the face and provides for inhalation and exhalation of low pressure air
   b. Exhalation valve – allows exhaled air to leave the facepiece and stops smoke and toxic gases from entering facepiece on inhalation
      1) Can sometimes become stuck, preventing exhaled air leaving by way of the exhalation valve; causes air to blow out around the face seal
      2) To correct, try blowing out hard while holding facepiece tight to face
      3) Positive pressure – exhalation valve on the facepiece is equipped with a pressure balancing mechanism – air does not continuously flow, but does maintain a positive pressure inside the facepiece
   c. Speaking diaphragm – allows wearer to communicate more clearly
   d. Nose cup – deflects exhalation away from lens to prevent fogging
   e. Spider or facepiece harness – strap which holds the facepiece firmly against the face. Be sure straps are fully extended when putting away (check for wear and tear)

II. MAINTENANCE AND INSPECTION

A. After Use Maintenance

1. Recharge/replace cylinder if at 90% capacity or less

2. Inspect "O" ring and gasket
3. Inspect facepiece
4. Clean facepiece
   a. Submerge in approved cleaner/ disinfectant with warm water
   b. Rinse in warm water
   c. Air dry – do not connect to regulator when low pressure hose is wet
5. Inspect and clean harness
6. Check operation of all gauges and valves

B. Cylinder Recharging

1. Secure SCBA cylinder in a fragment proof charging station when possible
2. Connect SCBA to cascade high pressure line
3. Open SCBA valve
4. Open cascade valve with the least pressure, but more than the SCBA pressure
   a. Watch gauges
   b. Cascade cylinders will follow a numerical or other predetermined order. Lowest pressure cylinder corresponds with the lowest numbered cylinder
   c. Never open more than one cascade cylinder at a time – this will cause cylinders to equalize
5. Close valve of cascade cylinder when pressure is equal to SCBA
6. Open valve of cascade cylinder with next highest pressure (next in predetermined order) and continue procedure until SCBA is fully charged
7. Shut valves
8. Bleed high pressure line
9. Disconnect SCBA – remove from charging station

C. Recommended Daily Inspection and Maintenance

1. Cylinder pressure
2. High pressure hose coupled to cylinder – should be finger tight
3. Operation of low pressure alarm
   a. Open cylinder valve
   b. Alarm should activate when pressure builds up and stops afterwards
   c. Check gauge on shoulder strap
   d. Alarm – Note pressure at which alarm starts to sound. Should be + of working pressure and continue until pressure reaches approximately 5 to 10% of working pressure
4. Straps fully extended
5. Check complete unit
   a. Cracks
   b. Cuts
   c. Abrasions
   d. Dents
   e. Missing parts
6. Cylinder secured to backplate and harness

D. Monthly Inspection and Maintenance – same as daily/weekly plus

1. Visually inspect all rubber parts for damage
2. Test cylinder and valves for air tightness with soapy water solution
3. Don and operate unit and check
   a. Airflow
   b. Noises
   c. Gauge readings
   d. Exhalation valve
   e. Anything else the manufacturer recommends

E. Defective Units

1. Remove from service
2. Tag
3. Repair or replace

F. Testing Schedule – Hydrostatic

1. Composite – every 3 years

NOTE: As per DOT regulations, 49 CFR 173.34(e), cylinder life on composite cylinders only is restricted to a fixed number of hydrostatic test dates. That number should be five

2. Regulator/high pressure hose assembly must be tested by an approved service center every 2-1/2 years

III. DONNING AND DOFFING PROCEDURES AND SAFETY CHECKS

A. Student Preparation

1. Harness and facepiece – all should be the same
   a. Cylinder up
   b. Cylinder valve at feet
   c. Straighten and extend all straps
   d. Facepiece on right of cylinder
2. Check apparatus to see if the cylinder valve is off and system bled

B. Pre-Donning Inspection

1. All straps (harness and facepiece)
   a. Take out twists
   b. Fully loosened
2. Valves – all connections hand tight
3. Read cylinder gauge (out loud during drills)
4. Open cylinder valve
   a. Listen for low pressure
      1) Will not activate if regulator has not been bled from previous use
      2) Remind students not to use SCBA if warning device does not activate
   b. Read regulator gauge and compare to cylinder gauge

C. Donning (two suggested methods)

1. Coat method
   a. Stand or kneel at valve end of cylinder
   b. With left hand, cross over backplate and grasp shoulder strap that will be worn on left shoulder
   c. Control the regulator (if applicable) with right hand
   d. Lift harness assembly and swing so that grasped shoulder strap is resting on left shoulder while right shoulder strap comes across the back to rest on right shoulder
   e. Secure harness
2. Over the head
   a. Kneel at the end opposite the cylinder valve
   b. Grasp backplate/cylinder with both hands
   c. Lift harness assembly overhead – let straps hang free, they will fall into place over the elbows
   d. Slide harness onto back in proper position
   e. Slide harness according to manufacturer's procedure
3. Don facepiece (five piece webbing)
   a. Chin first
   b. Place webbing over head
   c. Secure straps (in order)
      1) Neck
      2) Temple
      3) Top (if needed)
   d. Helmet chin straps must be used

4. Safety check
   a. Facepiece seal
      1) Hold hand over regulator connection on facepiece
      2) Inhale slightly and hold your breath momentarily (10 seconds)
      3) Facepiece should slightly collapse and there should not be any leakage or air. If leak is suspected – readjust facepiece and head straps and retry
   b. Exhalation valve check
      1) With hose in the regulator coupling, inhale and exhale to assure function
      2) Foreign matter may lodge in spring assembly

D. Operator
   1. Connect regulator to facepiece according to manufacturer's procedure
   2. Inhale to check regulator gauge function. Gauge reading should be equal to or within 100 psi. Believe the lessor of the two
   3. Positive pressure check – break seal with two fingers; check for outward rush of air
   4. Open purge valve to check for function

   NOTE: Make sure that the student's helmet is sitting properly on the head, and chin strap is secured.

E. SCBA Doffing
   1. Facepiece doffing
      a. Remove regulator from facepiece and secure in holder on waist strap
      b. Loosen facepiece spider straps by pulling forward the buckles provided
      c. Pull facepiece down so as to allow the chin to be removed, then lift facepiece over head. Finish loosening spider straps as in "ready position"
      d. Place in a clean area by right foot so as to protect the lens from scratching and the inside of facepiece and breathing tube from becoming wet or contaminated from dirt, dust, grit, or liquids
      e. Clean facepiece as described by manufacturer or see cleaning and stowing
   2. Doffing the harness
      a. Unbuckle waist and chest straps
      b. Loosen waist strap and fully let out using appropriate buckles. Loosen and let out shoulder straps all the way. Remove right shoulder strap from shoulder
      c. Reach to left shoulder strap with left hand
      d. Slide harness off left shoulder
      e. Place harness on floor with cylinder towards floor
      f. Extend all straps on the harness assembly
      g. Lay out straps and check to see that they are not tangled or twisted; straighten as necessary
      h. Shut off cylinder and bleed with purge valve

      NOTE: Upon completion of the last donning and doffing drill, have students remain in SCBA and sit on floor. Have them practice controlled breathing methods as they are described in next section.

F. Donning Drill
   1. Have students spread out in a large circle
   2. While in full protective clothing, each student shall don and place their SCBA in full operation within 1-1/2 minutes, using the four-step method
      a. Procedure: Students shall stand erect with hands above head. Donning and timing starts on the word "go." Students shall kneel or raise one hand in the air to indicate completion of task

3. Remove protective caps and connect quick fill hose to male connection on receiver unit – pressure of two cylinders will equalize within one minute

4. Disconnect hose, replace all protective caps, and bleed hose by pressing against solid surface, and replace in pouch with connections downward

B. Mouth-to-Cylinder Valve

1. Use when all else fails

2. Extremely dangerous when mouth is in direct contact with valve and valve is opened too much

3. Techniques

a. Turn off valve as soon as possible if high pressure line is damaged

b. Doff unit

c. Remove cylinder from harness

d. Place closed hand between cylinder and mount

e. Open valve slightly – opening too much will blow hand open instead of damaging lungs

f. Turn on and off as necessary

VI. CHANGING CYLINDERS

A. Spread apparatus out on floor with cylinder up

B. Point cylinder valve at feet

C. Extend and straighten all straps

D. Turn cylinder valve off

E. Bleed air off regulator by slowly opening purge valve

F. Disconnect H/P hose from cylinder (check "O" ring in H/P connector)

G. Loosen cylinder strap or holding device

H. Remove cylinder from backplate

I. Insert new cylinder to cylinder stop

J. Tighten cylinder holding device; securing cylinder to backplate

K. Check "O" ring in H/P connector before connecting high pressure hose

L. Check proper position of regulator and straps by donning apparatus

M. Turn cylinder valve on to check for leaks

N. Bleed system as in D and E above

ACKNOWLEDGMENT

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b. Instructor should call out time at one minute and each ten second interval thereafter until each student has completed task

c. Repeat as necessary

IV. CONTROLLED BREATHING TECHNIQUES

A. Breathing must be kept on a conscious level. Subconscious patterns result in breathing only through the mouth or nose

1. Nose breathing results in
   a. Short breaths
   b. Lungs not filled to capacity
2. Mouth breathing results in
   a. Rapid breathing
   b. Body cannot take full advantage of oxygen before exhalation

B. Suggested Patterns

1. In through nose – out through mouth
   a. Easy to learn and remember
   b. Close to normal pattern when speaking
   c. Techniques
      1) Breathe in slow and deep
      2) Hold in lungs 3-4 seconds for maximum oxygen/carbon dioxide exchange
2. In through mouth – out through nose
   a. Allows for good air exchange without holding breath
   b. Techniques
      1) Inhale rapid and full
      2) Exhale slowly
      3) Best method for strenuous work
3. Five-second count method
   a. Technique
      1) Inhale for 5 seconds using either of first two methods – slowly and fully
      2) Hold for 5 seconds
      3) Exhale for 5 seconds
      4) Hold for 5 seconds
      5) Repeat cycle
   b. Best for short rest breaks
4. Skip Breathing
   a. Emergency only – for conservation of air
   b. 30 minute SCBA may be extended to two hours
   c. Technique
      1) Inhale fully
      2) Hold breath for normal exhalation time
      3) Take additional breath before exhaling
      4) Exhale slowly
      5) Repeat cycle
   d. Important to remain mentally and physically calm

V. EMERGENCY PROCEDURES

NOTE: In the course of normal emergency operations, personnel may find themselves in a situation where they may become trapped; run out of air; or experience an equipment malfunction.

It is the intent of this section to demonstrate a number of techniques which may be considered as a last resort. These, however, may make the difference between life and death.

A. Quick Fill Procedure

1. Remove quick fill hose from pouch
2. Remove protective caps and connect quick fill hose to male connection near regulator on left shoulder strap of donor unit
   a. Female connection should snap in place
   b. Green ring should appear near female connection